The impact of digitalization in the economy on labor market outcomes in middle-income countries

by

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Using country-year panel datasets from 1995 to 2018 of 93 middle income countries, this research seeks to investigate the two-fold impact of digitalization on labor markets outcomes, both on women's labor force participation rates and gender wage gap. This study finds that there is a significant relationship between internet usage and the female labor force participation, as a 1% increase in internet usage is associated with a decline in female labor participation by 0.01 percentage point. In addition, the study finds that a 1% increase in broadband subscription leads to a decline of gender wage gap by about 0.06 points. Moreover, this study finds no evidence to support the relationship between broadband subscriptions and female participation, and the relationship between internet usage and gender wage gap. This research also conducts a cross-industry analysis in Cambodia to understand impact of digitalization across all industries on gender wage gap. However, the case study is not able to find a statistically significant result on how the rate of digitalization across industries is affecting gender wage gap. They key takeaway from this research speaks to the importance of digitalization and shows how digitalization can be a double edge sword. It can affect and infiltrate every sector of the society both positively and negatively. With that it carries the potential to change social interactions, labor market structure and require people to rely more on technology. Despite its limitations concerning data availability, this research is relevant and important for global policy context as noted both by the Beijing Platform for Action and the 2030 Development Agenda. It demonstrates both the urgency of action and the

need to understand why digitalization matters and how policies could prioritize women's equal access to digital technology and training as a way to enhance their skills and literacy.

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Preface

There are a great number of passionate and amazing individuals who have supported me in this research process and my past two years in doing my graduate education at GSPIA.

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1.0 Introduction

The fourth industrial revolution (4IR), also known as industry 4.0, is upon us. The rapid advancement of new emerging technologies and the escalation in technology usage is altering our society and infiltrating every sector of the economy. Industry 4.0 is different from previous industrial revolutions because this revolution brings together digital, physical, and biological factors (Schwab 2016). Industry 4.0 brings in new technologies such as, but not limited to, artificial intelligence, big data, computational design, computerization, and digital fabrication technologies. People will have to be equipped with skills and access to technologies in order to catch up with this revolution. Jobs and tasks are suspected to be replaced by machines or advanced by machines. Included in this revolution is the increasing rate of digitalization. Digitalization is the use of digital communication and digital media. Digitalization is growing in our society due to the rise of internet servers and broadband subscriptions, the rise of using computers, other technological devices, and the emergence of the digital economy such as online businesses and financial services. Digitalization has the potential to both facilitate and impede social change, while also change our social interactions.

This research seeks to investigate the profound impact of digitalization on the labor market outcomes by using a time series cross-country analysis of 93 middle-income countries. Using macro-level data from the World Bank's World Development Indicators and the International Labor Organization (ILO) datasets, this research studies how digitalization might have affected the labor market outcomes in middle-income countries from 1995 to 2018. This study seeks to unfold the impact of digitalization on the labor market outcomes in answering two questions.

1. It seeks to analyze the potential impact of digitalization on female labor force participation the middle-income countries. Will the increase in digitalization increase or decrease the labor force participation rate of women?
2. Second, does digitalization impact gender wage gap in the labor market?

In further investigation, this research will use ordinary least square (OLS) regression methods with country and year fixed effects to estimate the relationships between digitalization and the labor markets outcomes. This study uses internet usage and broadband subscriptions as indicators for digitalization.

The main findings of this research are: first, a 1% increase in internet usage decreases the female labor force participation rate by 0.01 percentage points; second, this study finds that a 1% increase in broadband subscriptions is associated with a reduction in gender wage gap by 0.06 points. A reduction in gender wage gap means that it improves positive outcomes for women's earnings. However, this research is not able to find a statistically significant relationship between broadband subscription and female labor force participation rate. Similarly, this study is also not able to find statistically significant effect of internet usage on gender wage gap. The case analysis of Cambodia is not able to find statistically significant result to support the relationship between the level of digital intensity in workforce's industries and gender wage gap. The digital intensity in each industry is measure as low, medium, and high according to whether a certain industry is incorporating certain of digitalization includes investment in information and communication technologies (ICTs), trainings in ICTs, and access to ICTs usage. The result of the study is met with many limitations due to the lack of data availability, variables and causality issues. The results of this study can be also be influenced by other confounding factors that affect labor market outcomes.

This paper sheds light on the important interlinkages of digitalization, gender, and labor market outcomes. It also seeks to explain the key factors by which digital technologies can be used to leapfrog opportunities to empower women in the labor market. Understanding the role of digitalization with gender components can potentially allow decision-makers to make better policy decisions that is gender-sensitive and targets women and allows them to be able to participate equally in the labor market. Women often lag behind men in terms of accessing to ICTs include their usage, and their skills and literacy. Women also are underrepresented in the STEM field. Gender sensitive policies potentially can further improve women access to not only ICTs but also market opportunities to contribute to the economic growth of the country. In the global context, world leaders have long committed to increasing efforts in promoting their citizens' access to digitalization and finding ways to integrate their economy to respond to digitalization. This is found in the case of the 2030 Development Agenda. Moreover, this study presses important issue that for policymakers, technology will not solve the problem of gender equality. Whether technology is positively or negatively impact gender equality outcomes, policymakers are at the important stage to make sure that women are equipped with the necessary skills and access to ICTs. This, in turn, can make them to fully realize their potential and participate in the labor market.

This study proceeds in eight sections. This first section provides an introduction to the study. Section 2 offers a literature review of trends of female labor force participation in middle-income countries, relationship between female labor force participation and digitalization, and gender wage gap. Section 3 discusses research methodology and section 4 provides results and robustness check. Section 5 develops a case study on Cambodia regards to the impact of digitalization in different industries on the gender wage gap. Section 6 discusses limitations of the

study along with its potential further research. Section 7 offers a discussion of the policy context for digitalization within the 2030 Development Agenda, while section 8 lists conclusions and takeaways.

2.0 Literature Review and Theoretical Framework

This research seeks to explain the phenomenon of the impact of digitalization on women's labor force participation rate and gender wage gap. This research also notes that many factors can impact the labor force participation rate and gender wage gap such as but not limited to GDP growth, trade and investment, public and social service provisions, and urbanization. In establishing a literature framework, this research compiles three branches of the literature that includes: the general overview of the trend of female labor force participation in middle-income countries, the prior research on digitalization and female labor force participation, and the relevant research discussing the impact of digitalization on gender wage gap.

2.1 What is digitalization?

The term "Digitalization" has often been used interchangeably with "Digitization". Digitalization refers to digital communication and digital media. In simple terms, digitalization is the use or leverage of technologies to create a new stream. Digitalization is how we use technology to move into new model of economy or businesses (Chapco-Wade, 2018). Meanwhile, digitization is an internal process to create a digital representation of certain attributes and provide cost reduction results (Chapco-Wade, 2018; Gupta, 2020). It is noted to important that digitalization cannot happen without digitization. These two concepts are interconnected but are not interchangeable. For example, digitalization is how we use digital technology to transform our

daily routine such as using internet to connect with another, whereas digitization is scanning photograph and making it into a PDF file.

Digitalization is the process of employing digital technologies and information to transform business operations in which provides valuable work (Muro et al. 2017). Digitalization is on the rise as people are using more computers, having more access to mobile phones and high-speed internet activities. Moreover, the online presence is also increasing through online activities such as the use of social media, online businesses, online and digital financial services, and other internet of things. The economy and the labor markets are being redefined, restructured, and transformed by digitalization (Muro et al. 2017). There are more than 8 billion mobile cellular subscriptions in 2019, compared to 2009 with only about 4.6 billion and in 1999 there were only 476 million mobile cellular subscriptions (Muro et al. 2017). In addition, there is also an increase in computer purchases.

For the purposes of this study, the research refers to digitalization in terms of the day-to-day information and communication technologies (ICTs) that include the internet, broadband subscriptions, mobile phones, and cellular internet.

2.2 Female labor force participation rate and the U-shape hypothesis

This research seeks to answer the question of "will digitalization decrease the female labor force participation?" However, focus remains on middle-income countries which are subjected to those economies classifying as emerging economies and newly industrialized countries. In which, these countries have shifted from agricultural activities towards manufacturing and service activities. As countries move from low-income status to middle-income status, the female labor

force participation tends to decline and as the countries are transitioning to high-income status, the female labor force participation increases, like a U-shaped curve (Sinha 1967; Boserup 1970; Psacharopoulos and Tzannatos 1989; Goldin 1995).

Goldin (1995) finds that poverty drove the female labor force participation rate to increase in low-income countries due to the lower level of income and the high share of agricultural production. During the lower income phase, societal production is oriented toward agricultural substenance that allow higher women's participation due to the increase of number of women working on family farms (Psacharopoulos and Tzannatos 1989; Goldin 1995). When countries transition into the middle-income phase, they enter the early industrialization phases where women's labor force participation decreases. In the early industrialization period, women are being left out because of the physical limitations, gender discrimination and the high domestic demands of large families (Pampel and Tanaka 1986). The early stages of middle-income phase, countries go through restructuring where farming becoming mechanized and industrial expansion in terms of manufacturing which require technologies (Pampel and Tanaka 1986; Goldin 1995). So, this causes women to leave the labor force and to be left out. Moreover, with the expansion of capital-intensive technologies in manufacturing industries, male labor is more preferable (Olivetti 2013). When countries are transitioning from middle-income to high-income, women's participation in the labor market increases due to the high level of education, increase in social protection and wages in the countries. When female education improves and the value of women in the labor market increase, women move back to the labor force (Goldin 1995).

2.3 Digitalization and female labor force participation rate

Existing research focuses more on the micro level rather the macro level or cross-country research. Only few studies have conducted similar research on cross national level. A panel study of 48 African countries concluded that the higher penetration of ICTs yields higher women's participation in the labor force (Efobi et al. 2016). There is a study focusing on the Indo-Pacific region that covered all countries in Asia, Oceania and the Pacific coast of the Americas. But the scope of the research still largely driven by majority of the advanced economies such as the U.S, Canada, Japan, Australia, Chile, New Zealand, and South Korea. Using internet usage as an indicator variable for digitalization, the growth in internet use is associated with four-fifths of the increase in women's participation in the labor force in the Indo-Pacific between 2000 and 2016 (Watson et al. 2018). This study is different from prior research and literature because this research looks at the middle-income countries and it spans across all regions in the world. Moreover, other research tend to use one measure for their studies, this study aims to use two measures of digitalization simultaneously to understand its impact.

In what way does digitalization affect female labor force participation? The role of digitalization can affect women's work by changing the dynamic and structure of the labor force through many channels including increasing access to better information, reducing their constraints within time and mobility, and increasing the demands for new jobs and market opportunities. All of these affected channels can potentially increase women's participation in the workforce. However, the positive impact of digitalization only matters if women have access to adequate digital technologies and have digital skills and literacy.

2.3.1 Increasing access to information

The increase in digitalization means that there is an increase in the use of ICTs to support people's everyday lives including in their jobs and daily activities. Moreover, digital technologies lower information barriers which allow women to have easy access to labor market opportunities (Dettling 2016). By providing more information, digital technologies can facilitate job searching, matching, and information sharing between employers and employees (World Bank 2016). Digital technologies can also potentially erase labor market discrimination where digital technologies increase the exchange of information between men and women, which over time will change mindsets (Nath 2001). This increased access to information allow both men and women to change their respective and view of one another in a new perspective. Thus, with access to better exchange of information, there can be a less discrimination against women in the labor market and the employer will likely hire women in the workforce.

2.3.2 Reducing time and mobility constraints

The rise of the internet, broadband, and mobile cellular has connected the world to become closer and also changes the dynamics of the workplace. Digitalization affects women's labor participation rate because it changes the labor market to become more flexible and increases the temporization of work (Webster 1996). The increase of temporary jobs, part-time work, self-employment, or teleworking increase options for women to participate in the labor force. The flexibility of the workforce allows women to be able to work from home and at flexible time. The increase in internet usage is associated with an increase in married women participation in the U.S labor force by 4.1 percentage point (Dettling 2016). An increase in internet means that women

have more access to search for more job opportunities. The rise of women participation workforce can be explained by the time saving in household works and the increase in teleworking as internet usage is rising (Dettling 2016, Viollaz and Wrinkler 2020). In Jordan, internet adoption can increase female labor force participation (Viollaz and Wrinkler 2020). The labor market has become more flexible as women can participate in teleworking from home without having to make decision to enter the labor force outside home.

2.3.3 Increasing demands for new jobs and market opportunities

In the United States, gaining access to broadband internet is associated with an increase in employment rate by 1.8 percentage points and the result shows a larger effect in rural areas of around 2.2 percentage points (Atasoy 2013). Furthermore, the increase of internet connectivity can reduce unemployment (Bagues and Sylos Labini 2007) while the increased mobile coverage in South Africa increases the wage employment by 15 percentage points and a fair share of this attribute to women (Klonner and Nolen 2010). Skilled based technological model predicted that as the level of technologies increases in the workforce, wages and demand for skilled labor also increases (Atasoy 2013). The widespread accessibility of broadband technology and internet usage affect the way that firms operate and enables them to become more digitalized and more technological and create new job and market opportunities (Valeberg 2020). Thus, they need skilled labor to complement those digitalization efforts. Moreover, digitalization also changes the workplace to become more digitized and rely on computers and advanced technologies to complete the tasks (Muro et al. 2017). In addition, digital technologies such as broadband or internet can increase the new market opportunities such as expand e-commerce and businesses. With digital technologies, entrepreneurs especially women can take advantage of expanding their businesses

and commerce beyond their local market. It provides more opportunities for women to participate in the market to expand their business presence especially online and earn higher incomes (Sicat et al. 2020).

2.3.4 Persisting gendered digital divide

While digitalization is expected to increase women's participation in the labor market as discussed above, only those who have the skills and education to do so will be able to take part in these outcomes. This research centers its argument around this framework to which the digital gender divide still persisted in the society where women are behind men in terms of accessing digital technologies, having digital skills, and reaping the impact of digital technologies. Women, in some middle-income countries, do not have the privilege and adequate education and skills to catch up with the rise of digitalization. This can put them in jeopardy, and it can limit them from participating in the labor market. The increase of ICTs in the workforce lead to an increase of the demand for skilled labor (Atasoy 2013). Women in middle-income countries are more likely to be occupied in the low-skilled or unskilled labor. In terms of supply, digitalization increases the free flow of information for women to learn about job opportunities easily. However, there are 200 million women fewer than men in the world who own mobile phones (Lin 2018). With less access to technological devices, women have less access to internet or broadband connection. This puts them behind in learning about opportunities or have skills to equally participate in the labor force as discussed above.

2.4 Digitalization and gender wage gap

Gender wage gap is impacted by many factors such as GDP growth, trade expansion, public investment, globalization and the education level. Generally, some research find that technological change has limited effect on gender wage gap. Women often work in the non-automated work and less exposed to technology; therefore, this has not led to a decline in gender wage gap (Cortes et. al, 2020). However, there is very little to no research documented the causal relationship between the increase of digitalization and gender wage gap. Gender wage gap often declines as women move up to higher positions as documented by much research (Blau &Kahn, 2017; Cortes et. al, 2018).

There are two avenues in which digitalization can impact gender wage gap. First, the gender wag gap can be impacted by how digitalization is influencing the job routineness and the automation of work. Digitalization could increase computerization and automation of work and which in turn can impact gender wage gap because women often work in the low level of occupations or their work will be completely replaced by computerization. This channel potentially depicts that digitalization can rapidly advance the tasks to be more computerized and automated due to the rise of internet servers and broadband subscription. Thus, internet and broadband subscription facilitate the workplace routine as such tasks can become more reliable on the use of internet or other digital factors. The rising demand of high-skilled labor show that that it has lowered relative wages for those who are in low-skilled labor. Job routines are influenced by digital technologies. Higher job routineness (also known as routine jobs) means that the jobs are easily codifiable through the use of digital technologies and defined by set of rules, whereas low job routineness (usually refers to abstract jobs) means that job require analytical, communicational and other technical skills (Brussvich et al. 2019). Job routineness level is accounted for about 5%

of gender wage gap in addition to other factors across the occupations in the United States (Brussevich et al. 2018). This means that if people are working in the lower job routineness task, they are less likely to earn more. The changing landscape of work especially in changing the job tasks can widen the gender differences in the earnings. In relation to the new waves of robots and computers in the workplace, robots decrease men's wages more than women's wages while the increase in computer capital reduces women's wages more than men's (Ge and Zhou 2020).

Second, digitalization can impact gender wage gap due to the increase of digital platforms and thus promote higher participation in the gig economy or platform economy. The gig economy and platform economy are on the rise as the internet, mobile cellular, broadband, and other digital factors are heavily infiltrating the economy. Online platforms might appear as gender-neutral; however, research has shown that this type of economy still has persisted gender pay gap. Barzilay and Ben-David (2017) discussed that the gender-blind algorithms is expected to promote equal access to jobs for women and provide them more flexible hour schemes. For example: the employers are incapable of knowing the gender of the employees on platform or gig economy. Using the data from crowdworking platform in 2015 and despite the gender-blind algorithm, there is a persisting gender wage gap occurs in the platform economy. Women only earn on average a dollar less per hour than men in the crowdworking platform (Adams-Prassl and Berg 2017). Women's average hourly earnings are $4.90 compared to $5.90 for men, which is about 82% of men's earning. In addition, digitalization increases the online platforms in the economy such as Uber, Lyft, and digital economy platforms such as online businesses and financial services. Other researchers find that women often work for more hours on those type of platforms; however, their hourly rates are significantly lower's than men. It is about two-third of men's hourly earnings (Renan Barzilay and Ben-David 2017). In addition, another research shows that in the Amazon

Mechanical Turk platform women on average earn about 20% per hour less than men (Adams-Prassl 2020). Gender wage gap in the platform and gig economy varies across platforms. With the absence of institutional and social protections like employer discrimination (since employers do not know the gender) and childcare and household responsibility (the gig and platform economy allow women and men to work at flexible schedule), gender pay gap somehow still exists. Indeed, the rise of digitalization might increase people especially women to be able to work in gig or platform economy. But digitalization such as the using technologies with algorithms can still show that women are still being discriminated against and gender wage gap still persists in those type of economy.

2.5 Theoretical framework

This research rests on the following hypotheses as research framework. This research seeks to answer two main questions about the impact of digitalization on the labor market outcomes in the middle-income countries. To understand digitalization, this study uses internet usage and broadband subscriptions as independent variables. This research uses internet usage and broadband subscriptions because these technologies are very important assets in the labor market. Other variables such as ICT investment, software investment, ICT intermediate goods, ICT intermediate services, robot use, online sales and ICT specialists are also good measure for digitalization. These variables are used in the OECD framework to measure industries' digital intensity. However, the lack of data availability regards to these measures hinders this research from using some of these measures. Internet usage and broadband subscriptions have abundant availability of data; therefore, this research proceeds to use these as measures for the analysis. People would need

access to internet and broadband in order to access certain information especially with job search. Therefore, it is very important to use these variables because they are potentially one of the factors that affect labor market outcomes. Potential limitations arise in using internet or broadband as measure. Section 6 points out those limitations. This research seeks to explain the effects on female participation rate and gender wage gap because these outcomes are important, and they are linked to women's economic empowerment opportunities.

The research focuses on middle income countries as selected countries because middle income countries make up about 75% of the world's population and 62% of the world's poor population (World Bank 2020). This group is filled with diverse countries with different socioeconomic factors, culture, and religion. The rise of digitalization in the middle-income countries have started to skyrocket since the year of 2000 and majority of the economies are continuing to grow rapidly. However, women are still lagging in accessing those digital devices. Today, 54 percent of women in low- and middle-income countries have access to use mobile internet and the gender gap is narrowing (GSMA 2020). Therefore, this group of countries provides a plausible puzzle to study.

The null hypotheses for this study state that digitalization does not have an effect on female labor force participation and gender wage gap. This study will test four hypotheses to answer the two main questions.

H1: The increase of internet usage will lead to a decrease of female labor force participation in the middle-income countries.

H2: The increase of broadband subscriptions will decrease the female labor force participation in the middle-income countries.

A large portion of the prior literature discussed that digital technologies such as internet, mobile phones or broadband are seen as tools to use to empower women and they can increase women's participation in the labor market. However, the framework is hypothesizing on the contrary because the literatures somehow ignore the persisting digital gender divide in the society. Women only able to receive the positive impact of the digital technologies only if they are equipped with the relevant skills and good access. As majority of women are lagging in access technologies, this research propose that the increase of this digitalization can have negative impact on women's labor market outcome.

H3: The increase of internet usage will increase gender wage gap in the labor market in the middle-income countries.

H4: The increase of broadband subscription will increase gender wage gap in the labor market in the middle-income countries.

While the prior research provide limited discussion on the relationship between gender wage gap and digitalization, this research notes that technology is not gender neutral or gender blind. Therefore, the impact of technology could negatively impact women's labor market outcome.

3.0 Research Methodology

3.1 Data

To test the hypothesis, this paper use country-year panel dataset to conduct the main analysis to answer whether digitalization is impacting the labor market outcomes includes female labor force participation rates and gender wage gap. The timeframe selection for this study is 23 years from 1995 to 2018. This timeframe is selected due to the rise of digitalization has started to increase around 1995. Therefore, this study believes that it is appropriate to conduct a study within this time period. This study uses the World Bank income group classification to determine the selection of countries. The study selects 93 countries from the middle-income countries classification, which are countries that have GDP per capita fall between $1,036 to $12,535. Some countries that are excluded from this analysis due to their lack of data and are majority micro and small island nations. The main source of the data come from the World Bank's World Development Indicators and the ILO STAT, a statistical website owned by the International Labor Organization (ILO). The gender wage gap data is very limited with only 37 countries make such data available and make up to only around 242 observations. Table 1 below defines all variables

used in the analysis and shows the sources of all the variables. Table 2 shows descriptive statistics with the mean and standard deviations for all variables.

Table 1 Description of variables and sources

Variable	Description	Sources
Internet usage	Percentage of individuals with access to internet	World Development Indicators
Broadband	Number of broadband subscription per 100 people	World Development Indicators
Female labor	Proportion of the populations age 15+ that is in the labor force	World Development Indicators
Gender wage gap	The wage gap between men's earning and women's monthly earning in 2017 $ PPP	International Labor Organization
Fertility	Total births per women	World Development Indicators
Urban population	Percentage of people living in urban area	World Development Indicators
Female secondary enrollment	Gross enrollment of female student in secondary education in %	World Development Indicators
GDP growth	Percentage growth	World Development Indicators
Government expense	General government final consumption expenditure includes all government current expenditures for purchases of goods and services. It measured as percentage of GDP.	World Development Indicators
Upper	Code as dummy variable: upper middle income countries=1, lower middle income countries=0	

Table 2 Summary of main regression variables

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
internet_usage	2,177	16.89	20.26	0	81.20
broadband	1,477	3.424	5.280	0	33.87
ln_broadband	1,477	-0.604	2.623	-9.210	3.523
ln_internet	2,177	1.237	2.785	-9.210	4.397
female_labor	2,232	48.36	16.32	8.440	87.16
gender_wage_gap	242	15.33	12.85	-19.19	70.68
fertility	2,229	3.133	1.295	1.085	6.918
urban_pop	2,232	51.52	19.26	10.88	91.87
female_secondary	1,392	70.96	25.82	4.811	137.7
gdp_growth	2,185	4.539	6.852	-62.08	150.0
govt_expense	1,980	15.27	9.542	0.911	147.7
upper	2,232	0.516	0.500	0	1

3.2 Model specifications

The study conducts the main analysis by using the ordinary least square regressions (OLS) with country fixed effects, year fixed effects and a vector of other control variables to avoid the omitted variable bias and other endogeneity issues.

Independent variables: This study uses digitalization as the independent variable. In order to determine digitalization, this study uses internet usage and broadband subscriptions as measures. To resolve the skewness of the data, the independent variable will be turned into a natural logarithm form. The regression specification with these variables as natural logarithm form allows this analysis to easily estimate the percentage change within the changes.

Dependent variables: For the labor market outcomes, the study first uses the female labor force participation rate as the main outcome variable, and second, it uses gender wage gap as another main dependent variable. Gender wage gap is not conditional on working as it is calculated from the women and men's earning data. Those earnings are related to gross renumeration in cash and in kind of paid to employees for the time work and renumeration for time not worked include vacation pay, holiday pay or paid leave. These earnings exclude social security, pension scheme, severance and termination pay.[1]

Control variables: To avoid the omitted variables biases, the regression analyses use five control variables. The confounding variables can impact the relationship and produce a biased estimate; therefore, it is necessary to control these variables: fertility rate, share of urban

[1] For more information regards to the measure of the earnings please visit the following: https://ilostat.ilo.org/resources/concepts-and-definitions/description-earnings-and-labour-cost/

population, female literacy rate, government spending as percentage of GDP, and GDP growth. Countries with high GDP growth or high government spending can potentially correlate with higher internet usage and broadband as well. Countries continue to invest more in their ICT infrastructure as they are further developing. Moreover, higher GDP growth and high government spending also associate with increasing in the labor market outcomes. Blau (2008) discusses that fertility rates are also associated with increasing the labor supply; therefore, controlling for this will allow the analysis to reduce the biases from these factors.

Fixed effects: Including country and year fixed effect can provide better and credible results. Holding country fixed effects, the study can examine the changes within countries, and it controls for constant unobserved heterogeneity between countries. Similarly, for year fixed effects, this control for factors that are changing each year and is common for all countries in the given year.

Time lag: The regression analysis will lag all of the variables in order to avoid any endogeneity to produce an unbiased estimate. The analysis will lag all of the variables by one year. Absence of lagging can lead to potentially biased results. For example, internet usage usually does not have an actual effect at the current year. The internet data from 2006 will not produce impact perhaps until a year later or two year later, 2007 or 2008. Without lagging, the result of the estimate might be caused by the prior years of the internet usage data. Therefore, lagging the variables will capture this feature and is appropriate for this study.

Regression specifications: With OLS regression, this study will conduct four analyses. First, this study attempts to analyze the relationship as stated in H1, the impact of internet usage on internet usage. The model specification is shown below:

$$female\_labor_{it} = \alpha_1 + \beta_1 * \ln\_internet\_usage_{i(t-1)} + \lambda_1 * Z_{i(t-1)} + i.year + i.country + e_{it} \quad (1)$$

female_labor$_{it}$ is the main outcome variable for this equation, it measures the female labor force participation rate aged 15 years and older in country *i* in period *t. ln_internet_usage* is the natural logarithm of the proportion of individuals in country *i* in period *t* with internet access. Z_{it} is the vector of all of the five control variables (fertility rate, share of urban population, female literacy rate, percentage of government spending on final consumptions of GDP, and GDP growth). This regression model also includes the time and year fixed effects. The use of these fixed effects allows this study to avoid any heterogeneity within the different years and between different countries that share different social and cultural factors. β_1 is the main estimator of this equation in estimating the relationship between internet usage and female labor force participation rate.

The second model specification is used to estimating the relationship between broadband subscription and the female labor force. Similarly, to equation 1, equation 2 is as follows:

$$female\_labor_{it} = \alpha_2 + \beta_2 * \ln\_broadband_{i(t-1)} + \lambda_2 * Z_{i(t-1)} + i.year + i.country + e_{it} \quad (2)$$

ln_broadband is the natural logarithm for the measure of the number of people with fixed broadband subscription per 100 population in country *i* in the period *t.* β_2 is the main estimate for this equation.

The third regression model is used to test hypothesis 3, the relationship between internet usage and gender wage gap.

$$gender\_wage\_gap_{it} = \alpha_3 + \beta_3 * \ln\_internet\_usage_{i(t-1)} + \lambda_3 * Z_{i(t-1)} + i.year + i.country + e_{it} \quad (3)$$

gender_wage_gap is the measurement of the earning gap between women's earnings and men's earnings in 2017 PPP USD in country *i* in the period time *t.* Based on the calculation from Busse and Spielmann (2006), gender wage gap is computed as 1 minus the women's earning rate divided by the men's earning rate times 100. The higher number of the earning gap show there is a higher inequality among the earnings between men and women. β_3 is the main coefficient of interest in this equation.

Similarly, for hypothesis 4, the fourth regression model is used to estimate the effect of broadband on gender wage gap as seen in equation 4.

$$gender\_wage\_gap_{it} = \alpha_4 + \beta_4 * \ln\_broadband_{i(t-1)} + \lambda_4 * Z_{i(t-1)} + i.year + i.country + e_{it} \quad (4)$$

3.3 Threat to internal validity

Establishing a causal relationship between digitalization and labor market outcomes in terms of female labor force participation and gender wage gap is very difficult. There are three threats that this study is cognizant of: first, omitted variable biases can impact the analysis and the relationship due to both digitalization and labor market outcomes can be impacted by many other confounding variables. However, this study uses multiple fixed effects, lagging methods, and control variables to overcome this endogeneity and biases. Second, there is an expectation to reverse causality as the relationship that this study is seeking can follow in both directions whether digitalization is affecting labor market outcomes or labor market outcomes can impact digitalization. For example, internet usage can impact the female labor force participation rates, but the female labor force participation rates can also influence or stimulate internet usage. However, the methodology of lagging the variables discussed above can overcome this threat. Nevertheless, this study makes an assumption that digitalization is impacting the labor market outcomes. Third, this study recognizes that the countries selected for the analysis are heterogeneous societies that have a different and diverse backgrounds from cultural factors, economic system, geography location, income level, and other socio-economic factors. Therefore, controlling for time and country fixed effects will allow this analysis to overcome the current threats to the internal validity.

4.0 Results and Discussion

The following section presents results to the main analysis. The section is divided into four sub-sections generating the results in response to the four hypotheses. Each regression runs in four models. Model 1 is the simple OLS regression analysis between the dependent variable and the independent variable. In model 2, the regression is run only with additional controls without any fixed effects. In model 3, this study estimates the regression results with years fixed effect. And in model 4 is a full specification that includes all variables and both country and year fixed effects.

4.1 The impact of internet usage on female labor force participation rate

Table 3 indicates all of the model specifications of the regression for internet usage and female labor force participation. The regression result finds a strong significant relationship between internet usage and female labor force participation rate. In table 3, this study runs the regression in four models. The regression results show that in model 1 without any additional controls and fixed effects, the regression coefficient β_1 is -0.596. This shows that an increase of 1% in internet usage will lead to a decrease -0.006 percentage point in the female labor force participation rate. When the analysis adds additional controls, model 2 shows a positive coefficient but insignificant p-value. In model 3 and model 4, the result is a similar trend of the model 1 which internet usage decreases the female labor force participation rate. In model 4, once all fixed effects are accounted and all control variables as added, a 1% increase in the internet access in the middle-income countries lead to about 0.01 percentage point decrease in female labor force participation

rate. This estimation is significant at 1 percent level ($p<0.01$). Moreover, once the fixed effects are added, the R-square value are high which imply that countries and different years are accounted for the variation in the dependent variables, and it is driven by the country net effect as country fixed effects is added in model 4. Therefore, the results shows that there is a significant difference in this relationship and thus determines that internet usage is associated with the decrease of female labor force participation rates. This result firmly supports the hypothesis 1.

Table 3 Relationship between internet usage and female labor force participation rate

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4
L.ln_internet	-0.596***	0.0380	-1.804***	**-0.982*** **
	(0.141)	(0.260)	(0.513)	**(0.279)**
L.fertility		1.851***	1.425**	-0.803
		(0.615)	(0.620)	(0.809)
L.urban_pop		-0.207***	-0.171***	0.0608
		(0.0328)	(0.0335)	(0.143)
L.female_secondary		0.0771**	0.0900***	-0.0396
		(0.0336)	(0.0325)	(0.0274)
L.govt_expense		-0.0100	-0.0287	0.0428
		(0.0338)	(0.0357)	(0.0537)
L.gdp_growth		0.130	0.135	-0.00101
		(0.149)	(0.168)	(0.0190)
Constant	49.10***	47.50***	36.64***	43.49***
	(0.417)	(4.363)	(5.518)	(8.205)
Observations	2,084	1,208	1,208	1,208
R-squared	0.011	0.064	0.082	0.980
Country FE	NO	NO	NO	YES
Year FE	NO	NO	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

However, a big change in internet usage will make this magnitude to be larger, for example: if Cambodia increases internet by 10%, there will be about a 0.1 percentage point decline in women participation in the labor market. This finding is inconsistent with majority of prior studies. Prior literatures have found that internet usage increases the female labor force participation rates. Moreover, this finding seems consistent with the U-hypothesis where it offers that women labor force participation rate is decreasing in the middle-income countries. This result shows a decreasing women labor force participation rate, and this could also be explained by other confounding factors that are not controlled for or the U-hypothesis as most middle-income countries are experience a stagnant or declining women labor force participation.

4.2 The impact of broadband subscriptions on female labor force participation rate

Table 4 provides the four-model specification of the OLS regression between broadband and the female labor force participation rate. The regression analysis shows that there is no significant difference in the relationship between broadband subscriptions and female labor force participation rate. Across all models, it seems that broadband is negatively associated with female labor force participation, where $\beta_2 < 0$. In model 4, with all control variables and fixed effects, the estimate coefficient is -0.378. However, the coefficient p-value is larger than 0.10, so the result is not significant. Therefore, this study fails to reject the null hypothesis since this study does not have enough evidence to support the relationship between these two variables.

Looking solely at the coefficient, this study can discuss that on the contrary with the prior research. Prior research has found that increasing broadband will increase female labor force participants. However, past research conducted in the advanced economies context which are

different set of countries from this analysis. This research does not expect the insignificant result from this analysis in table 4, this research expects that the result would show similarities to table 3. However, this result can be different because perhaps broadband has much less data available compare to internet usage.

Table 4 Relationship between broadband and female participation rate

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4
L.ln_broadband	-0.686***	-0.393	-1.131**	**-0.378**
	(0.178)	(0.277)	(0.444)	**(0.257)**
L.fertility		2.153***	1.624**	0.157
		(0.756)	(0.802)	(1.132)
L.urban_pop		-0.162***	-0.132***	0.186
		(0.0388)	(0.0410)	(0.159)
L.female_secondary		0.121***	0.126***	-0.0596**
		(0.0382)	(0.0376)	(0.0298)
L.govt_expense		0.0281	0.00276	0.00849
		(0.0299)	(0.0348)	(0.0376)
L.gdp_growth		0.231	0.297	0.0355
		(0.153)	(0.188)	(0.0331)
Constant	48.05***	40.39***	40.76***	24.89**
	(0.407)	(5.200)	(6.606)	(10.49)
Observations	1,384	866	866	866
R-squared	0.013	0.060	0.073	0.984
Country FE	NO	NO	NO	YES
Year FE	NO	NO	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.3 The impact of internet usage on gender wage gap

Table 5 provides the results of all four OLS model specifications between internet use and gender wage gap. This study finds that there is no significant relationship between the internet usage and gender wage gap in all of the four model specifications. Across all of the models, there is a negative relationship between internet usage and gender wage gap, as internet usage increase, gender wage gap will decrease ($\beta_3 < 0$). There is a negative insignificant relationship between

Table 5 The relationship between internet usage and gender wage gap

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4
L.ln_internet	-1.001	-1.999	-2.385	**-1.600**
	(0.798)	(1.750)	(2.073)	**(4.544)**
L.fertility		4.095**	3.919*	6.999
		(2.029)	(2.122)	(11.63)
L.urban_pop		0.0949*	0.102	0.586
		(0.0571)	(0.0717)	(0.856)
L.female_secondary		0.107	0.112	-0.0744
		(0.0852)	(0.0819)	(0.104)
L.govt_expense		-0.203	-0.210*	-0.0158
		(0.129)	(0.126)	(0.213)
L.gdp_growth		-0.0937	-0.0671	0.0813
		(0.332)	(0.403)	(0.309)
Constant	18.62***	0.897	-2.119	-24.87
	(2.839)	(10.37)	(10.59)	(71.10)
Observations	242	171	171	171
R-squared	0.005	0.058	0.093	0.865
Country FE	NO	NO	NO	YES
Year FE	NO	NO	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

internet use and gender wage gap. The coefficient is -1.6. However, the result is not significant with p-value < 0.10. Unfortunately, this study is not able to find a statistically significant result to support the relationship between internet usage and gender wage gap data. This study fails to reject the null hypothesis.

4.4 The impact of broadband subscriptions on gender wage gap

In Table 6, the findings illustrate the negative and significant relationship between broadband and gender wage gap across all four models. Once additional controls and fixed effects are accounted, the coefficients decrease as seen from Model 1 with $\beta_4 = -0.37$ to Model 4 with $\beta_4 = -6$. The addition of control variables and additional fixed effects make the coefficients become smaller. The negative coefficients mean that gender wage gap is getting smaller, or it is decreasing. This declining in gender wage gap means that gender wage gap is narrowing, and this is an improved outcome. At p-level < 0.05, the result show that a 1% increases in broadband subscription is associated with the decline of gender wage gap by 0.06 points.

Table 6 The relationship between broadband and gender wage gap

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4
L.ln_broadband	-0.365	-2.934**	-3.412**	**-6.001****
	(0.612)	(1.281)	(1.497)	**(2.855)**
L.fertility		2.307	1.892	10.03
		(1.869)	(1.977)	(9.293)
L.urban_pop		0.136**	0.148**	0.121
		(0.0616)	(0.0744)	(0.742)
L.female_secondary		0.135	0.143	-0.0875
		(0.0887)	(0.0879)	(0.104)
L.govt_expense		-0.243*	-0.257**	0.0298
		(0.125)	(0.120)	(0.184)
L.gdp_growth		-0.201	-0.210	0.115
		(0.302)	(0.377)	(0.295)
Constant	15.72***	-1.674	-8.279	-20.48
	(1.241)	(9.324)	(10.26)	(41.05)
Observations	242	171	171	171
R-squared	0.002	0.082	0.121	0.873
Country FE	NO	NO	NO	YES
Year FE	NO	NO	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This result is on the contrary to the literature discussed above and this result is the opposite to the hypothesizes statement, H4. This magnitude of the effect is quite large. A 0.06-point decrease in gender wage gap can show that a 1% increase broadband has a strong significant impact on gender wage gap. Thus, a 10% change in broadband is associated with a narrowing of gender wage gap by 0.6 points. However, there are only about 37 countries have gender wage gap resulting in about a maximum of 242 observations.

4.5 Result summary

Table 7 presents the summary of the regression results with the main coefficients from the analysis. The relationship between digitalization and female labor force participation rate and the relationship between digitalization and gender wage gap are contrast with one another. In column (1) and (2), there are negative coefficients, where in column (3) and (4) there are positive effects despite the negative coefficients. The negative coefficients mean that there is a reduction in gender wage gap. In column (1), the result is significant, so a 1% change in internet usage is associated with a decrease by about 0.01% in women's labor force participation rate. In column (2), the result is not statistically significant. Column (3) result is not statistically significant. Only coefficient in column (4) is statistically significant where a 1% increase in broadband subscriptions is associated with a reduction of 0.06 points in the size of gender wage gap. Arguably, there is a larger impact

Table 7 Summary of main regression results

VARIABLES	(1) Female LFP	(2) Female LFP	(3) Gender Wage Gap	(4) Gender Wage Gap
L.ln_internet	**-0.982***** (0.279)		**-1.600** (4.544)	
L.ln_broadband		**-0.378** (0.257)		**-6.001**** (2.855)
Constant	43.49*** (8.205)	24.89** (10.49)	-24.87 (71.10)	-20.48 (41.05)
Observations	1,208	866	171	171
R-squared	0.980	0.984	0.865	0.873
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

in the reduction of gender wage gap which can show that digitalization is associated with improving gender equality outcome in the labor market. This impact could outweigh the negative impact of digitalization on women's labor force participation rates.

Moreover, in appendix A, an additional regression result is shown to compare the male labor force participation rate versus female labor force participation rate. While the results are not statistically significant, the magnitude of the effect for male labor force participation rate is much smaller than women. Digitalization is associated with a larger decrease in female rate compared to male rate. Appendix table 1 shows this result. Only column (1) and (2) provide statistically significant results. While a 1% or 10% increase in internet usage is associated with a decline of 0.01 or 0.1 percentage point female labor force participation rate, a 1% or 10% increase in internet usage is associated with a decrease of only 0.003 or 0.03 percentage point in male labor force participation rate. So, the effect on male labor participation rate is much smaller and this might not be able to reduce the labor force participation gap between men and women. It would be different if the male effect is much larger than it can say that if male effect outweighs the female effect, it can reduce the labor force rate gap.

The key takeaway is that digitalization is a double edge sword, and it can pose both positive impact and potential challenges in labor market outcomes. An in-depth discussion on the importance of digitalization is discussed in section 7 and 8.

4.6 Robustness check analysis

The group of middle-income countries includes a range of countries whose GDP per capita varies from about $1,036 to $12,535. Therefore, running a regression analysis on these selected countries cause a reservation to whether the results are captured among those diverse countries. This robustness analysis checks whether dividing up the sample to upper-middle income and lower-middle income countries provides a different explanation from the main analysis. In this robustness check, the analysis codes countries that are upper-middle-income as 1, and 0 otherwise. Appendix table 2 shows the robustness check of the relationship between internet usage and broadband with female labor force participation rates. In column (1) and (2), no significant results were found once the analysis has conducted separately between upper-middle-income countries and lower-middle-income countries. However, the coefficients for both in columns (1) and (2) show a negative relationship between internet and female labor force participation rates in both income group, which is a similar direction to the main regression in Table 3. Similarly, in columns (3) and (4), there are no statistically significant results regards to the relationship of broadband and female labor participation rates. In column (3), it shows that broadband subscription is associating with the decline of women's labor participation in upper-middle-income countries compared to column (4), broadband subscriptions are associating with the increase of women's labor participation. The statistically insignificant result is similar to what the research have found in the main regression between broadband subscriptions and female labor participation rates. However, across all four columns, no significant results were found.

Appendix table 3 documents the regression analysis with gender wage gap as the dependent variable. In column (1) and (3), the results show that there is a significant negative relationship between digitalization and gender wage gap. In column (1), a 1% increase in internet usage will

decrease gender wage gap by 0.034 points for upper-middle-income countries. In column (3), a 1% increase in broadband subscriptions is associated with gender wage gap decreasing by 0.03 points. In this case, the study shows that in the upper-middle-income countries, digitalization is associated with the decline of gender wage gap similar to the main findings. In column (2) and (4), there is an insignificant results documenting the relationship between digitalization and gender wage gap in the lower middle-income countries. In column (2), there is a positive relationship between internet usage and gender wage gap while column (3), there is a negative relationship between broadband subscription and gender wage gap. The regression in appendix table 3 is somehow met with limitation due to the lack of available data related to gender wage gap. Nevertheless, the result of the estimation between broadband and gender wage gap in the upper-middle income is robust and support the main regression results. On the other hand, there is no significant results to conclude for the estimation in the lower-middle income countries.

5.0 Cambodia Case Study

5.1 Context

Cambodia is a country located in Southeast Asia, it is one of the major garment manufacturing export in the region, alongside its neighbor, Vietnam. Cambodia serves as a case study for this study because it has great data availability regards to the men and women's earnings by different industries. Moreover, Cambodia also recently moved from low-income status into a lower-middle income status and has established itself as an emerging economy among the regions. Cambodia has planned and crafted its policy to integrate its economy to align with the industry 4.0 and the digital transformation. As seen in figure 1, since 2002 the proportion of users with internet has increased and it is continued to do so in the near future. In 2002, nearly 0% of the whole population has access to the internet. In 2018, about 40% of the population has increased their access to internet. However, this access to internet is not equally distributed across all of the

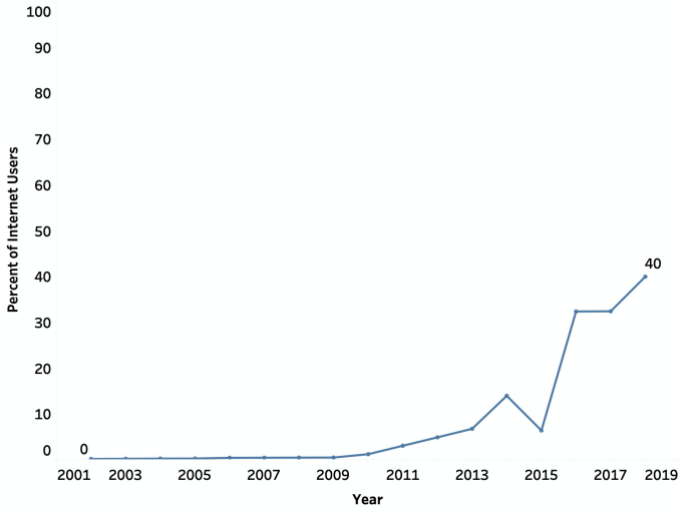

Figure 1 Trend of internet usage as percent of population in Cambodia

population. There is clear digital divide between those who live in urban versus rural areas and the divide between men and women. About 78% of Cambodian men has access to mobile phone compared to only 62% of Cambodian women. Most importantly, in regard to internet usage, only 30% of Cambodian women have access to the internet compared to 37% of Cambodian men. (LIRNE Asia 2018). Cambodia also ranks as one of the countries that have the lowest stage of digital readiness; however, efforts have been made (Heng 2018). In 2016, Cambodia scoresa about 3.4 out of 7 on the network readiness index (World Economic Forum 2016). However, Cambodia has improved its digitalization efforts in terms of increasing its ICT infrastructure development. The country also has a very competitive telecommunication market and small digital presence for digital economy and businesses online presences (Heng 2018). However, challenges still persist in the country.

5.2 Gender wage gap in different industries

Looking at the labor force of Cambodia, while digital presence is still relatively low; efforts are being made to digitalize the economy step by step. Moreover, it is important to note the distribution of the gender wage gap and the demographics of the Cambodian labor force by industries. Figure 3 shows the gender wage gap across the industries of the Cambodian labor force, using 2016 data. The bar chart shows that information and communication sector has the highest gender wage gap at 63, meaning that women only earn about 37% of what men earned. The sector with the lowest gap is finance and insurance activities where the gap is only about 0.87, meaning that women and men receive their earning nearly equal. The art, entertainments and recreation

sector show a negative gap of -17, which depicts women actually earn about 17% higher their male counterparts.

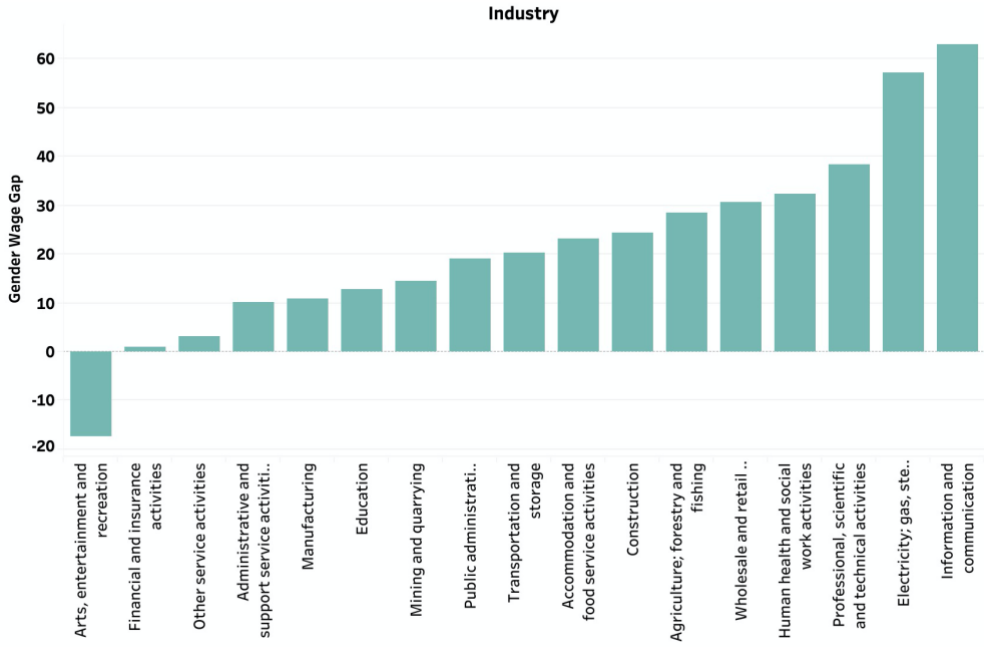

Figure 2 Gender wage gap across different industries in Cambodia

In the highest gender pay gap industry, women make up the information and communication sector only about 25% of the sector's workforce. On the other hands, in the arts, entertainment and recreation, women make up the majority with 75%, the highest across all industries and it is the only industries where women earn higher than men. There are about seven industries where women make up the majority, yet in those industries the gender wage gap still persisted except art, entertainment, and recreation. Those industries are education, other services activities, professional, scientific, and technical activities, accommodation and food services,

manufacturing, wholesale and retail trade, and health and social work activities. Figure 3 show the demographics of all workers across different industries in Cambodia.

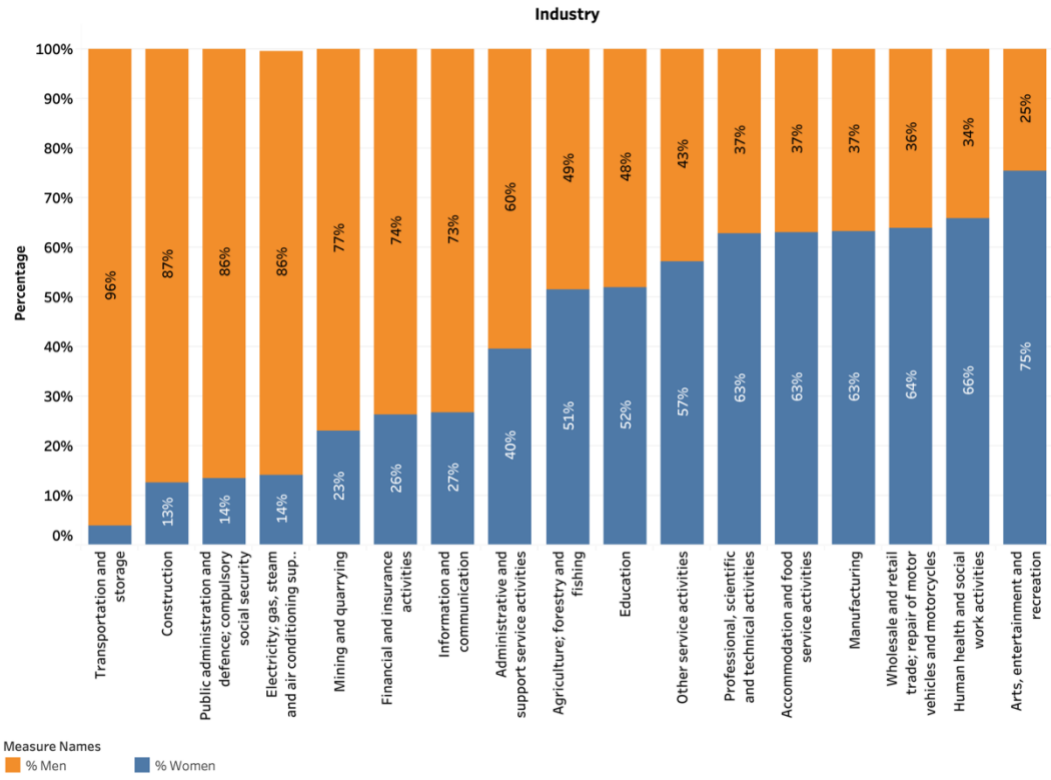

Figure 3 Distribution of workers by gender across industries

5.3 Case study analysis and results

5.3.1 Analysis framework

Using the framework from the OECD measurement of digital intensity by each sector, this study performs a OLS regression to estimate the relationship between the digitalization of each industry and the gender wag gap among those industries. According to the OECD framework, the framework categorizes each industry into different level of digital intensity on seven factors: ICT investment, software investment, ICT intermediate goods, ICT intermediate services, robot use, online sales and ICT specialists. Industries are classified into three quartile: low, medium (medium low/high) and high. The low quartile show that the industry has very low digital intensity in terms of its seven factors ranges from ICT investment to ICT specialists and vice versa. Using this framework, table 8 is the representation of the selected industry use in this case study analysis. This study notes a potential weakness for this case analysis due to the framework integration.

Table 8 Level of digital intensity in each industry

Industry Sector (ILO Classification ISIC Rev 4)	Digital Intensity Level
Accommodation and food service activities	Low
Administrative and support service activities	High
Agriculture; forestry and fishing	Low
Arts, entertainment and recreation	Medium
Construction	Low
Education	Medium
Electricity; gas, steam and air conditioning supply	Low
Financial and insurance activities	High
Human health and social work activities	Medium
Information and communication	Medium
Manufacturing	Medium
Mining and quarrying	Low
Other service activities	High
Professional, scientific and technical activities	High
Public administration and defence; compulsory social security	Medium
Transportation and storage	Low
Wholesale and retail trade; repair of motor vehicles and motorcycles	Medium

Using the framework from the OCED region might not be comparable to explore the digital intensity in Cambodia and can affect the credibility of the result. This study assumes that the digital intensity across the industries is somehow comparable due to the limited discussion around this topic in non-OECD countries. This study codes the industry into three level of intensity: 1 for the industry has low digital intensity, 2 for medium digital intensity and 3 for high digital intensity. From the ILO statistics, this study has the data of both men and women earnings across all selected 17 industries from 2010 to 2016 and other data includes: the number of employed persons in each industry and the number of average weekly working hours per employee by industry.

The analysis uses a cross-industry dataset from the years 2012 to 2017. The case study will provide an in-depth discussion to the cross-industry differences on the differential impacts of gender wage gap is produced by the intensity of digitalization by different industry. In addition to using the rate of digital intensity based on the OECD framework to classify the industries based on their level of digitalization by low, medium, and high digital intensity. The study uses the

Table 9 Summary of case study analysis variables

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	mean	sd	min	max
earning_women	115	400.8	171.2	124.7	896.5
earning_men	115	497.1	220.3	163.8	1,338
gender_wage_gap	115	17.01	23.09	-138.3	63.01
low_intensity	115	0.296	0.458	0	1
high_intensity	115	0.191	0.395	0	1
medium_intensity	115	0.513	0.502	0	1
total_hours	98	46.65	5.810	31.80	55.30
men_hours	98	46.03	6.687	29.30	57.70
female_hours	98	46.60	5.441	33.20	57.10
total_labor	98	555.3	1,010	12.10	4,636
men_labor	98	272.4	535.9	3.900	2,356
women_labor	98	282.8	490.1	7.100	2,280

earnings for women and men by industry from the International Labor Organization based on ISIC Rev 4.0 industry classification. Table 9 shows the summary of the data for the case study.

5.3.2 Results and discussion

The result of this specification is presented in table 10. In column (1), the model is used to estimate the impact of varied intensity level across industries on gender wage gap. Unfortunately, there is no statistically significant evidence that can prove that the digitalization in different industries contribute to a gender wage gap since the coefficients are insignificant. In column (2),

Table 10 The impact of level of digitalization on gender wage gap and earnings

VARIABLES	(1) Gender Wage Gap	(2) women's earning	(3) men's earning'
medium_intensity_level	7.236	64.08*	146.0
	(6.803)	(35.72)	(86.13)
high_intensity_level	-2.986	215.6**	249.6**
	(4.871)	(83.80)	(114.9)
L.men_labor	0.00859	-0.133**	-0.116
	(0.0112)	(0.0594)	(0.122)
L.women_labor	-0.00920	0.0759	0.0257
	(0.0123)	(0.0835)	(0.155)
L.men_hours	-0.942	6.677	0.344
	(0.884)	(4.214)	(8.166)
L.female_hours	0.970	-8.751	-1.946
	(1.054)	(5.390)	(11.34)
Constant	16.69	336.5**	351.6
	(16.12)	(144.6)	(252.0)
Observations	81	81	81
R-squared	0.153	0.585	0.404
Year FE	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

the estimation effect shows that for industry that have medium digital intensity, women tend to have higher earning than women who are working in the low digital intensity industry. Women in medium digital intensity level industry earn about $64 higher than women in the low digital intensity level industry. This coefficient is significant at 5% level. Similarly, women in the high digital intensity industry are more likely to earn about $215 higher than those who work in the low digital intensity industry. This result is significant at the 1% level. In comparison, column (3) is the estimation result between the digital intensity of industry and men's earning. The study finds that men who are working in the high intensity industry are more likely to earn about $250 higher than the men who are working in the low intensity industry. This estimate is significant at the 1% level. In summary, this case study concludes that there is an insignificant result regards to the impact of the digital intensity of the industries on the gender wage gap.

However, it is important to note the persisting gender wage gap existing across the industries despite the insignificant results that this study found. While this gender wage gap might

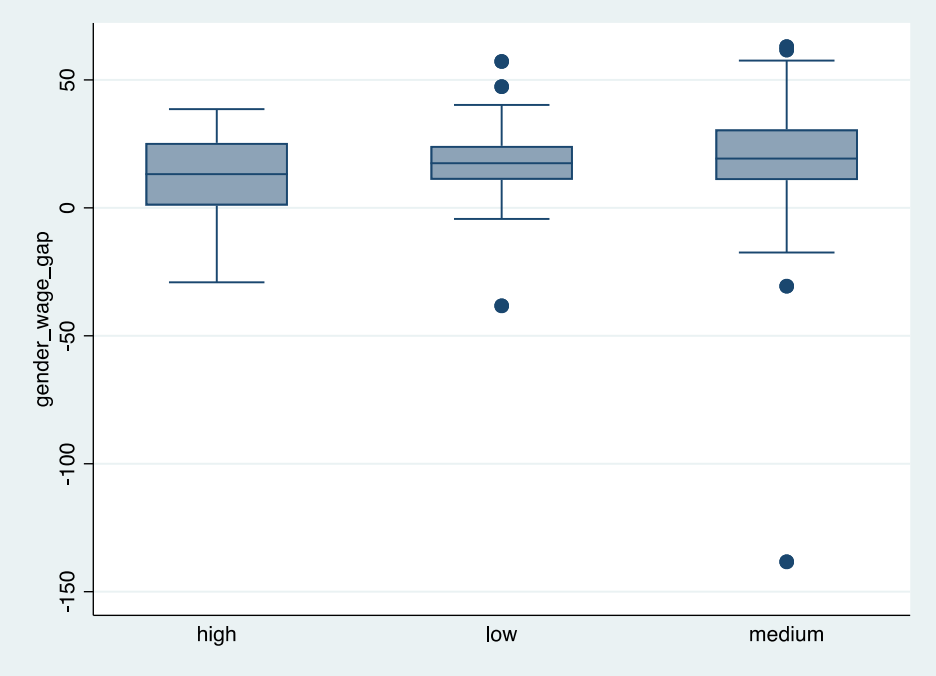

Figure 4 Gender wage gap and the level of digial intensity

not be causing by the digital intensity of the industry, this gender wage gap is influenced and impacted by many other factors that can be discrimination in pay between men and women, the assigned tasks, laws and policies and other socio-economic factors. Figure 4 represents the gender wage gap in the different intensity level of the industries. As seen from the figure, the gender wage gap is visible across all three different intensity level. The higher the number show that there is a higher gender wage gap, where men earn higher than women. In this figure, it shows that majority of the industries have existing positive gender wage gap (where men earn more than women), with a few other outliers. In the high digital intensity industry, the gender wage gap ranges from the maximum of 39 to the minimum of -29. It is interesting to point out that, 25% of the industries in the high digital intensity level have a negative gender wage gap, meaning women who belong into those 25% industries usually earn more than their male counterparts. In the low digital intensity industry, the minimum gender wage gap is close to 0 while the highest gender wage gap is about 47, so women only earn about 57% of men's earnings. In the medium digital intensity industry, the minimum gender wage gap is -17 which mean that women earn 17% higher than men. On the other hand, the maximum gender wage gap for this level is about 61, showing that women earn about 39% of men's earning in the industry that has medium digital intensity level. Overall, at least 75% of the industries in the high digital intensity level have a positive gender wage gap (where men earn more than women) compared to 95% of industries in low digital intensity and about 80% of the medium digital intensity.

Cambodia, as a nation, still needs to pursue serious steps towards digitalization, which includes promotion of carefully articulated and implemented gender equality laws and policies in its labor market and institutions. Empirical results show that there is no statistically significant evidence to document the relationship between digitalization and gender wage gap. The data

visualization further illustrates that gender wage gap is still persisting across all of the industries in Cambodia especially in different digital intensity level.

6.0 Limitations

This study is met with many limitations that can be resolved for future research. First, there is an obstacle in data collection regards to gender wage gap. Since gender wage gap is a calculation involving the earnings of women and men, it is very difficult to receive abundant data related to women and men's earnings in the middle-income countries. The earnings data should also be sex disaggregated. Out of the 93 countries selected in the study, only 37 countries have at least two years of women and men's earnings data. If these data are readily and publicly available, the study would have produced more significant and credible results.

Second, the limitation came from the measures used for digitalization. Research have shown the difficulty in using internet and broadband as predictors due to the nature of its randomness. Internet users are not randomly assigned and therefore, this can likely to be endogenous to the labor market participation (Dettling 2016). Therefore, future researchers should potentially use different variables to proxy digitalization. Potential digitalization variables can be ICT investment which is important to capture the countries' absorption of digitalization, ICT specialists which is vital to determine the ICT training content, and firm-level technology absorption which provides an effective indicator in measuring the country or industry prone to digitalization.

In addition, there can be potential limitation with causality in establishing the relationship conducted in this study. This study simply uses the OLS regression method. Therefore, there could be potential other factors that impact the relationship this study is seeking, and it is difficult to establish the causality with this method. A more sophisticated design could be using an instrumental variable approach. An instrumental variable approach can be used in establishing the

causal inference between digitalization and, female labor force participation rates and gender wage gap. A potential instrumental variable can be the regime type. There is a research that focuses on the diffusion of internet or technologies in countries according to the different type of regimes. Democracies are more likely to diffuse internet or broadband widely than autocracies; therefore, we could expect to find differences on the impact of digitalization diffusion in those countries (Milner 2006). So, these differences can impact the female labor force participation rates or gender wage gap differently. Employing regime type as instrumental variable can allow the future study to determine the impact of regime type on digitalization. This can establish a potential causation whether digitalization is impacting the labor market outcomes. However, regime type can also be impacted by other confounding factors as well; thus, a further investigation would be needed if this variable is being used. Moreover, the degree of internet freedom is also another good instrumental variable. It provides a good causal inference analysis to understand how the degree of internet freedom is impacting internet usage or broadband access and then how the digitalization is impacting the labor market outcomes. Using the degree of internet freedom, a study finds has a positive and significant result to the impact of internet on women's labor force participation (Watson et al. 2018). One last potential variable that can use as instrumental variable is terrain or geographical feature. Terrain can affect the usage of digital technologies especially the digital communication and telecommunication. Mountain and terrain can impede the availability of digital technologies and thus this is another good variable that can be used to employ the effect for causality.

7.0 Policy Outlook: 2030 Development Agenda

While it is very difficult to establish the causality between digitalization (internet and broadband) and labor market outcomes (women labor force participation and gender wage gap), this study offers a number of promising venues. The increase of internet usage is associated with the decline of female labor force participation rates and surprisingly, the increase in broadband subscription is associated with the closing of gender wage gap. While these results are subjected to several limitations discussed above, it is important to note that women still face many barriers and obstacles in benefiting from these new waves of rising technologies. The result of this study should be also be seeing technology as a tool that is used to enhance the future and it should be used effectively. If technology is hurting women, there should be appropriate and effective policy to reverse this particular outcome. In this case, if the rise of digitalization is associating with the decline of women labor force participation, the policy should be implemented to reverse this outcome. In the following section, this research provides an outlook for future policy context with three discussions on the importance of the 2030 Development Agenda, a global commitment spearheaded by the United Nations. This section does not attempt to provide policy recommendations based on the results of this study; however, it attempts to shine light on the importance to why digitalization should matter for policy makers especially in relation to the global context of the global commitment.

The global community remains hopeful that technologies and digitalization can bring good impacts to the citizens; however, only with effective and gender sensitive public policies technologies will be able to produce gender equal impact for all. Policymakers are very optimistic on the role of technologies and the increasing rate of digitalization. This is seen and documented

in the United Nations' Sustainable Development Goals (SDGs) in which technologies should use to empower women, youths need to have digital skills and literacy and least developed countries should be covered by internet servers. The SDGs are the global commitment in providing sustainable development to the citizens of the world. There are 17 goals that aim to improve the life of not only human beings, but also include those lives on lands and under water. In relation to the rise of digitalization, the 2030 Development Agenda or the SDGs propose five indicators across four SDG Goal 4, 5, 9, and 7 to push member countries to commit and promote people access to digitialziation in terms of usage, skills, and literacy. Women around the world are falling behind men in terms of their access to digitalization. This is in terms of their access to mobile phones, internet, computers, or even digital literacy. Women, overall, face significant barriers in both accessing ICTs and participating equally in the labor market. Therefore, the current 2030 Development Agenda is very important for countries to enact better policies to respond to the rise of digitalization. However, these SDGs target are met with limitations. Only two indicators require sex disaggregated data to support the target. Those targets and indicators are:

- Target 4.4: To substantially increase the number of youth and adults with relevant skills
    - Indicator 4.4.1: Proportion of youth and adults with ICT skills, by type of skills
- Target 5.b: Enhance the use of enabling technology, in particular information and communications technology, to promote women's empowerment
    - Indicator 5.b.1: Proportion of individuals who own a mobile telephone, by sex

Collecting and analyzing sex disaggregated data is important for policymaking because it allows the policymakers to implement and enact inclusive policies that can respond to variety of needs among the people. These indicators are important for the future of digitalization because

digitalization can contribute to the sustainable development. It provides a clear statement to policymakers in making policies to increase women in not only accessing to mobile phones but also to provide trainings to develop their digital skills and literacy.

Moreover, the other indicators are broadly defined and do not require sex disaggregated data. It is important to note that the lack of sex disaggregated data in these indicators is the potential weakness of the SDGs. Collecting good data can allow the policymakers to make better policy decisions in supporting the population, especially those who are left behind. If the data do not collect and capture those who left behind, the policy that is driven by that data will continue to leave the vulnerable population out. The other indicators that posit the important role of digitalization in the sustainable development cover in Goal 9 and 17.

- Target 9.C: To increase the access to information and communication technologies in least developed countries by 2020
    - Indicator 9.c.1: Proportion of population covered by a mobile network, by technology
- Target 17.8: To enhance the use of enabling technology
    - Indicator 17.8.1: Proportion of individuals using the Internet

These two indicators are also very important and relevant for the rise of digitalization in the economy. However, these two latter indicators fail to capture the sex disaggregated statistics and therefore, these indicators might not be adequate in supporting gender sensitive policy decisions.

Supporting and achieving the 2030 development agenda is vital for sustainable development. This research calls for the importance and urgency that there is need for policy

makers to pay close attention to the digitalization indicators in the SDGs. For a more gender equal future, digitalization should be prioritizing to promote and achieve economic and sustainable development.

8.0 Conclusion

In conclusion, digitalization remains essential for sustainable development and no one should be left behind in accessing digital technologies. Contrary to existing literature, this study suggests that internet usage is associating with the decline of female labor force participation rates in the middle-income countries. Moreover, the research is able to show that an increase in broadband is associated with the declining of gender wage gap. On the other hand, it was not able to find statistically significant evidence to support the impact of broadband on female labor participation and the impact of internet usage on gender wage gap. Cambodian case study provides no statistically significant evidence to understand if digitalization across industries is impacting the gender wage gap. However, it provides an in-depth look into the persistent gender wage gap across industries by their digital intensity level. This research provides an important leeway for countries to prioritize their policies to cope with the impact of digitalization and most importantly, to look back at their commitment toward the Beijing Platform for Action and the 2030 Development Agenda. In doing so, policymakers are able to produce the inclusive and effective policies that support their people as their countries and economies continue to progress toward industry 4.0.

A further research can be explored with using a potential different research design that includes using the instrumental variables and perhaps using other measures to employ the variation effect for digitalization. The lack of data availability is also a factor that limit the results of this study especially in the gender disaggregated data related to gender wage gap and digitalization. Having better data availability might improve the credibility of this research.

The key takeaway from this research finding is digitalization is a double edge sword because it can produce both positive and negative impact on labor market outcomes for women. Potential policies should be able to understand this double edge effect and aim to provide effective and gender sensitive policies to increase access for women to digital technologies and prevent the negative impacts produced by those technologies.

Digital technologies are important for women because they offer opportunities to leapfrog and advance women's opportunities in the society (OECD 2018). It also notes that digital technologies are not a silver bullet in resolving all gender inequalities issues (Sicat et al. 2020). However, using digital technologies effectively can benefit society and bridge the digital gender divide in improve women's opportunities in society includes earning higher income and participating in the labor force.

If women continue to lag behind men in terms of accessing digitalization, they can potentially be left out of the labor force or will not be able to absorb the benefits from the increased digitalization in the economy. This is important although digitalization brings optimism and new structures of labor markets, it somehow still signifies that women are not benefiting from this digitalization. If women do not have access to those digital technologies, they will not be able to cope with the rise of temporization of work, telework, the gig and digital economies, and activities where technologies are the mains sources of day-to-day interaction.

It is essential for policymakers to prioritize in bridging the gender digital divide and increase women access to internet, and perhaps other digital access includes mobile phones and broadband. Gender sensitive policies can provide women's access to technologies, ICT skills and literacy. Providing and expanding access for women to use internet, mobile phones and other digital technologies is important factor in bridging the digital gender divide and reversing the

negative impact that technologies can have on women. Including women to have access to technologies also allow them to receive the benefits from those technologies to participate in the society fully. Women are able to gain a great number of benefits from using digital technologies (OECD 2018). Having women accessing digital technologies does not only refer to them using digital technologies, but this also means that the countries need to provide necessary ICT infrastructure to support the digitalization efforts in the countries. Having efficient and effective infrastructure will facilitate the usage of digital technologies and thus, allow people to able to access them easily (Watson et al. 2018).

Having access is important, but having digital skills and literacy are also necessary for most women. Having digital skills and literacy allow women to be equipped and ready to participate with the increase of digital connectivity in the economy (Watson et al. 2018). Trainings on basic ICT skills is important in providing women the knowledge on how to navigate in the digital world. This comes to how to use the internet, how to use computer, and how to navigate the digital system in terms of digital finance, job searching and online formation assessment. Female users tend to use fewer digital services than men because they are less confident in using the digital platforms (OECD 2018). Therefore, there is a need to create online tutorial or upskilling initiative to support women to gain their confidence and skills. Moreover, including ICT skills as compulsory education is also important in bridging the digital gender divide. It removes obstacle for people to access skills and literacy and provides them a crucial pathway to gain basic competence in ICT skills and literacy (OECD 2018).

Digitalization also brings importance to work-life balance and other social protection policies. Increasing women participation in the labor markets through digital platforms should align with maintaining the job quality (OECD 2018). Both men and women should still be able to

receive equal benefits for their labor market opportunities. The rise of technologies might lead to more flexible working hours or teleworking hours; therefore, this brings light to policies should provide social protection to workers especially to women in terms of job security and work-life balance policies. This is also referring to the social protection policies especially in terms using online platforms to search for work or work in general, women should be prevented from any cyber bullying or online harassment that might be encountered on the platforms. Gender sensitive trainings should be conducted to provide people awareness on online harassment and discrimination through the use of digital technologies. So, there should be a better law. Social protection policies should be gender sensitive.

If countries are prioritizing policies to bridge the digital gender divide, women will have better opportunities to access digital technologies and fully participate in the economy equally with their equipped digital skills. Moreover, other gender sensitive policies include maintaining job quality, work-life balance, and social protection especially those protection policies to prevent online harassment/discrimination should be prioritized. Discrimination can happen anywhere and everywhere both offline and online. Achieving so, policy makers can potentially reverse the outcome of how technologies can potential hurt women, increase women participation in the labor market, increase their representation in the digital and technology fields, and potentially can close gender wage gap.

Appendix A Additional Regression "Male versus female labor force participation rate"

Appendix Table 1 Digitalization impact on male LFP versus female LFP

VARIABLES	(1) Male LFP	(2) Female LFP	(3) Male LFP	(4) Female LFP
L.ln_internet	**-0.301***	**-0.982*****		
	(0.163)	(0.279)		
L.ln_broadband			**0.161**	**-0.378**
			(0.173)	(0.257)
L.fertility	0.700	-0.803	1.984**	0.157
	(0.600)	(0.809)	(0.796)	(1.132)
L.urban_pop	-0.131	0.0608	-0.0456	0.186
	(0.0982)	(0.143)	(0.106)	(0.159)
L.female_secondary	-0.0518***	-0.0396	-0.0582***	-0.0596**
	(0.0191)	(0.0274)	(0.0207)	(0.0298)
L.govt_expense	-0.0221	0.0428	-0.0374	0.00849
	(0.0357)	(0.0537)	(0.0265)	(0.0376)
L.gdp_growth	-0.0139	-0.00101	0.0215	0.0355
	(0.0174)	(0.0190)	(0.0252)	(0.0331)
Constant	84.52***	43.49***	71.95***	24.89**
	(5.312)	(8.205)	(6.661)	(10.49)
Observations	1,208	1,208	866	866
R-squared	0.962	0.980	0.976	0.984
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix B Robustness Check

Appendix Table 2 Digitalization and female labor force participation rate by lower middle vs upper middle income countries

VARIABLES	(1) Upper-middle income	(2) Lower-middle income	(3) Upper-middle income	(5) Lower-middle income
L.ln_internet	**-0.749**	**-0.465**		
	(0.473)	(0.313)		
L.ln_broadband			**-0.354**	**0.184**
			(0.288)	(0.353)
L.fertility	-1.680	-1.339	-1.073	-0.671
	(1.249)	(1.060)	(1.445)	(1.318)
L.urban_pop	-0.0411	0.0876	0.0923	0.175
	(0.159)	(0.244)	(0.148)	(0.265)
L.female_secondary	-0.0195	-0.0501	-0.0505*	-0.0634
	(0.0323)	(0.0492)	(0.0297)	(0.0563)
L.govt_expense	0.0277	0.0289	0.0779	-0.00839
	(0.117)	(0.0480)	(0.109)	(0.0304)
L.gdp_growth	0.0285	-0.0396	0.0951**	0.0260
	(0.0222)	(0.0392)	(0.0418)	(0.0608)
Constant	49.63***	51.23***	30.99**	43.75***
	(10.12)	(11.12)	(12.24)	(12.54)
Observations	638	570	468	398
R-squared	0.971	0.987	0.982	0.989
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 3 Digitalization and gender wage gap by lower middle vs upper middle income countries

VARIABLES	(1) Upper-middle income	(2) Lower-middle income	(3) Upper-middle income	(4) Lower-middle income
L.ln_internet	**-3.366****	**5.152**		
	(1.603)	(12.90)		
L.ln_broadband			**-2.602***	**-13.54**
			(1.277)	(8.440)
L.fertility	13.70**	9.532	18.50***	13.33
	(6.260)	(27.64)	(6.044)	(18.38)
L.urban_pop	-0.365	0.736	-0.344	0.976
	(0.663)	(2.466)	(0.695)	(1.971)
L.female_secondary	0.0537	-0.595	0.0501	-0.178
	(0.0853)	(0.755)	(0.0932)	(0.760)
L.govt_expense	-0.474	0.0620	-0.332	-0.0736
	(0.659)	(0.370)	(0.645)	(0.389)
L.gdp_growth	0.0121	-0.112	0.0325	0.176
	(0.201)	(1.017)	(0.210)	(0.967)
Constant	19.80	-14.64	-4.933	-87.12
	(51.97)	(216.6)	(51.49)	(167.9)
Observations	94	77	94	77
R-squared	0.960	0.826	0.959	0.848
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix C List of countries

Appendix Table 4 List of countries used in the main regression analysis

Country	ISO	Income classification	Region
Albania	ALB	upper-middle	Europe and Central Asia
Algeria	DZA	lower-middle	Middle East and North Africa
Angola	AGO	lower-middle	Sub-Saharan Africa
Argentina	ARG	upper-middle	Latin America and the Caribbean
Armenia	ARM	upper-middle	Europe and Central Asia
Azerbaijan	AZE	upper-middle	Europe and Central Asia
Bangladesh	BGD	lower-middle	South Asia
Belarus	BLR	upper-middle	Europe and Central Asia
Belize	BLZ	upper-middle	Sub-Saharan Africa
Benin	BEN	lower-middle	Sub-Saharan Africa
Bhutan	BTN	lower-middle	South Asia
Bolivia	BOL	lower-middle	Europe and Central Asia
Bosnia and Herzegovina	BIH	upper-middle	Europe and Central Asia
Botswana	BWA	upper-middle	Sub-Saharan Africa
Brazil	BRA	upper-middle	Latin America and the Caribbean
Bulgaria	BGR	upper-middle	Europe and Central Asia
Cabo Verde	CPV	lower-middle	Sub-Saharan Africa
Cambodia	KHM	lower-middle	East Asia and the Pacific
Cameroon	CMR	lower-middle	Sub-Saharan Africa
China	CHN	upper-middle	East Asia and the Pacific
Colombia	COL	upper-middle	Latin America and the Caribbean
Comoros	COM	lower-middle	Sub-Saharan Africa
Congo, Rep.	COG	lower-middle	Sub-Saharan Africa
Costa Rica	CRI	upper-middle	Latin America and the Caribbean
Cote d'Ivoire	CIV	lower-middle	Sub-Saharan Africa
Cuba	CUB	upper-middle	Latin America and the Caribbean
Djibouti	DJI	lower-middle	Middle East and North Africa
Dominican Republic	DOM	upper-middle	Latin America and the Caribbean
Ecuador	ECU	upper-middle	Latin America and the Caribbean
Egypt, Arab Rep.	EGY	lower-middle	Middle East and North Africa
El Salvador	SLV	lower-middle	Latin America and the Caribbean
Equatorial Guinea	GNQ	upper-middle	Sub-Saharan Africa
Eswatini	SWZ	lower-middle	Sub-Saharan Africa

Fiji	FJI	upper-middle	East Asia and the Pacific
Gabon	GAB	upper-middle	Sub-Saharan Africa
Georgia	GEO	upper-middle	Europe and Central Asia
Ghana	GHA	lower-middle	Sub-Saharan Africa
Guatemala	GTM	upper-middle	Latin America and the Caribbean
Guyana	GUY	upper-middle	Latin America and the Caribbean
Honduras	HND	lower-middle	Latin America and the Caribbean
India	IND	lower-middle	South Asia
Indonesia	IDN	upper-middle	East Asia and the Pacific
Iran, Islamic Rep.	IRN	upper-middle	Middle East and North Africa
Iraq	IRQ	upper-middle	Middle East and North Africa
Jamaica	JAM	upper-middle	Latin America and the Caribbean
Jordan	JOR	upper-middle	Middle East and North Africa
Kazakhstan	KAZ	upper-middle	Europe and Central Asia
Kenya	KEN	lower-middle	Sub-Saharan Africa
Kyrgyz Republic	KGZ	lower-middle	Europe and Central Asia
Lao PDR	LAO	lower-middle	East Asia and the Pacific
Lebanon	LBN	upper-middle	Middle East and North Africa
Lesotho	LSO	lower-middle	Sub-Saharan Africa
Libya	LBY	upper-middle	Middle East and North Africa
Malaysia	MYS	upper-middle	East Asia and the Pacific
Maldives	MDV	upper-middle	South Asia
Mauritania	MRT	lower-middle	Sub-Saharan Africa
Mexico	MEX	upper-middle	Latin America and the Caribbean
Moldova	MDA	lower-middle	Europe and Central Asia
Mongolia	MNG	lower-middle	East Asia and the Pacific
Montenegro	MNE	upper-middle	Europe and Central Asia
Morocco	APR	lower-middle	Middle East and North Africa
Myanmar	MMR	lower-middle	East Asia and the Pacific
Namibia	NAM	upper-middle	Sub-Saharan Africa
Nepal	NPL	lower-middle	South Asia
Nicaragua	NIC	lower-middle	Latin America and the Caribbean
Nigeria	NGA	lower-middle	Sub-Saharan Africa
North Macedonia	MKD	upper-middle	Europe and Central Asia
Pakistan	PAK	lower-middle	South Asia
Papua New Guinea	PNG	lower-middle	East Asia and the Pacific
Paraguay	PRY	upper-middle	Latin America and the Caribbean
Peru	PER	upper-middle	Latin America and the Caribbean
Philippines	PHL	lower-middle	East Asia and the Pacific
Russian Federation	RUS	upper-middle	Europe and Central Asia

Samoa	WSM	upper-middle	East Asia and the Pacific
Sao Tome and Principe	STP	lower-middle	Sub-Saharan Africa
Senegal	SEN	lower-middle	Sub-Saharan Africa
Serbia	SRB	upper-middle	Europe and Central Asia
South Africa	ZAF	upper-middle	Sub-Saharan Africa
Sri Lanka	LKA	lower-middle	South Asia
Suriname	SUR	upper-middle	Latin America and the Caribbean
Tanzania	TZA	lower-middle	Sub-Saharan Africa
Thailand	THA	upper-middle	East Asia and the Pacific
Timor-Leste	TLS	lower-middle	East Asia and the Pacific
Tonga	TON	upper-middle	East Asia and the Pacific
Tunisia	TUN	lower-middle	Middle East and North Africa
Turkey	TUR	upper-middle	Europe and Central Asia
Turkmenistan	TKM	upper-middle	Europe and Central Asia
Ukraine	UKR	lower-middle	Europe and Central Asia
Uzbekistan	UZB	lower-middle	Europe and Central Asia
Venezuela, RB	VEN	upper-middle	Latin America and the Caribbean
Vietnam	VNM	lower-middle	East Asia and the Pacific
Zambia	ZMB	lower-middle	Sub-Saharan Africa
Zimbabwe	ZWE	lower-middle	Sub-Saharan Africa

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